

- Create a compact low cost biotelemetry unit that will monitor patient's blood pressure, heart rate and temperature
- Transmit patient data wirelessly for evaluation at local PC
- LabVIEW to display real time patient data and evaluate data for emergency situation

Sensors

- Blood Pressure Sensor
- Electrocardiogram (ECG)
- Temperature Sensor

Blood Pressure Sensor

- Flexible Diaphragm Tonometer
 - non-invasive blood pressure
 - real-time data acquisition
 - compact

measurement

Reasons for Rejecting Tonometer

- Precision manufacturing required
- Lack of available design information
- Time constraints

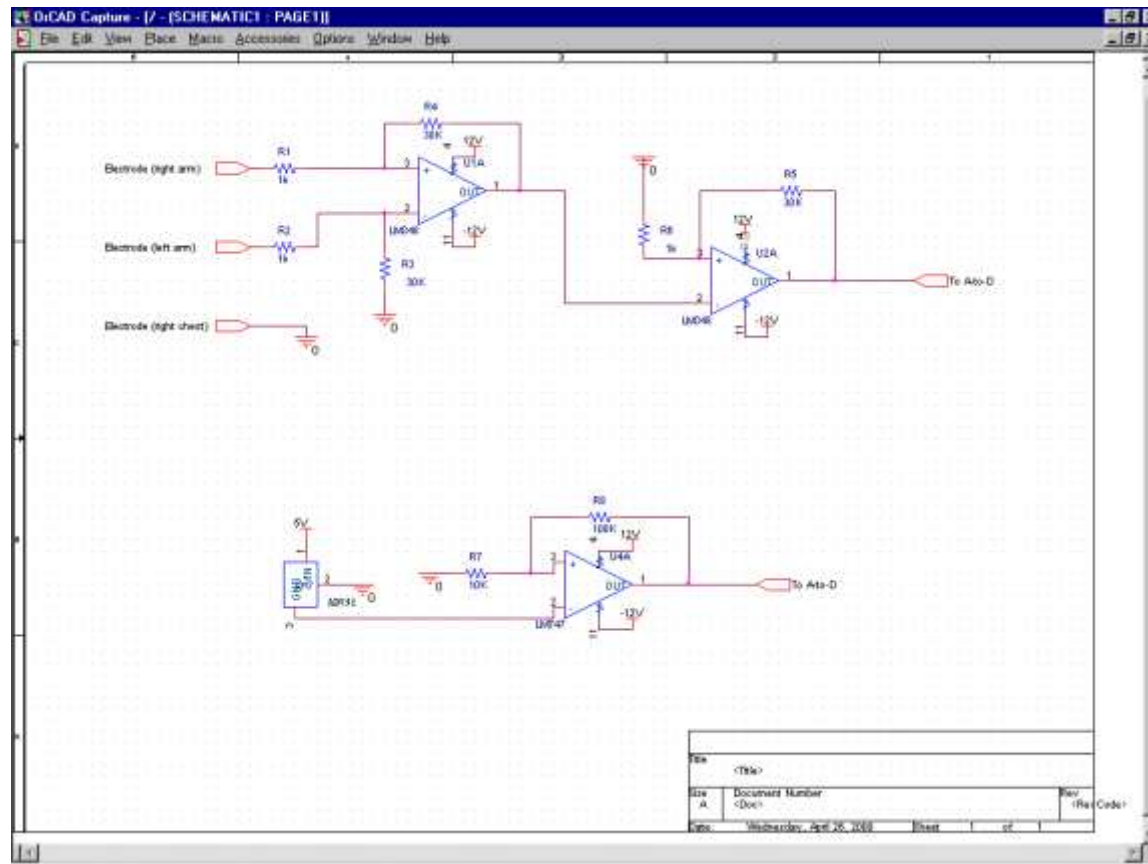
Electrocardiogram (ECG)

- Chosen as replacement for blood pressure sensor
- Allows measurement of patient's pulse
- Can be further expanded for accurate cardiac diagnostics

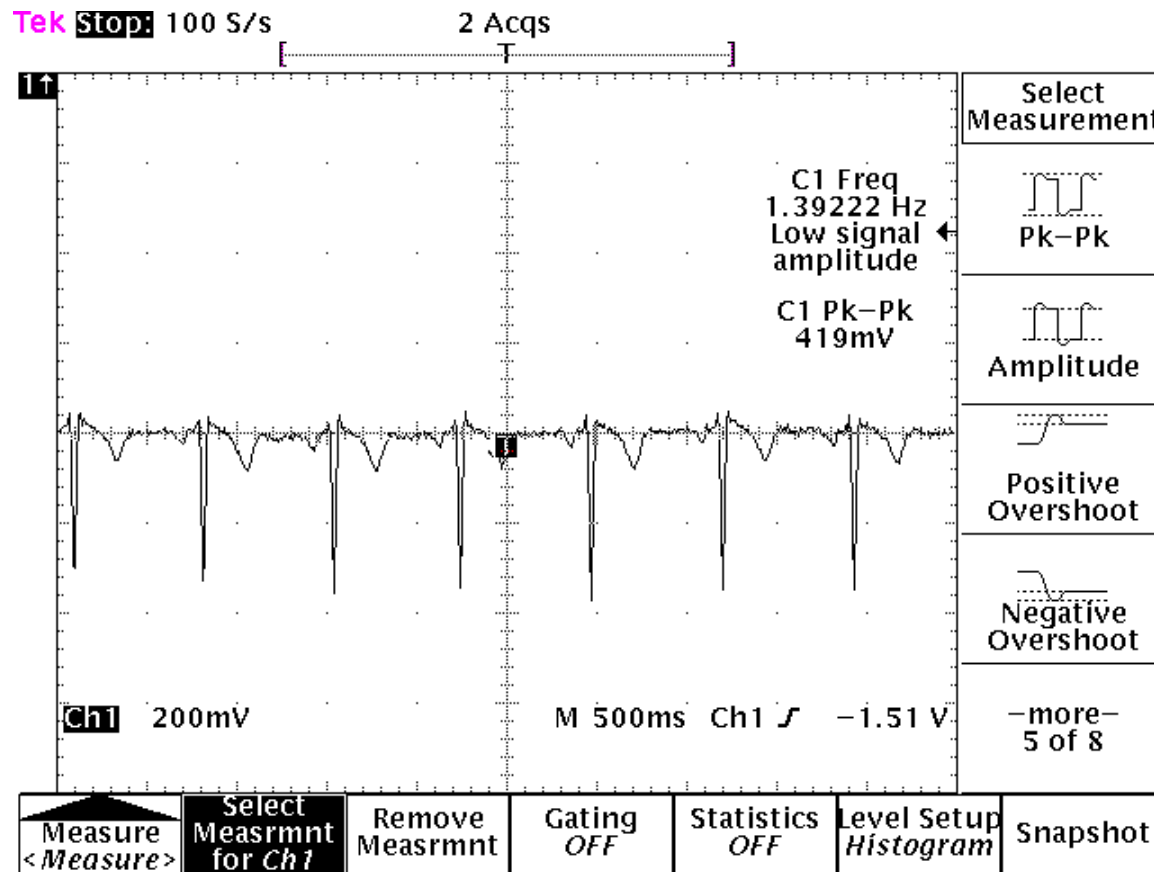
ECG Circuit

- Three electrodes used to obtain signal -
Left arm, Right Arm (Signal)
 - Right Chest (Ground)
- Amplitude of ECG signal is a few millivolts
- Differential amplifier used to measure changes in biopotentials sent through electrodes
- Non-inverting amplifier used to further amplify signal to a few volts

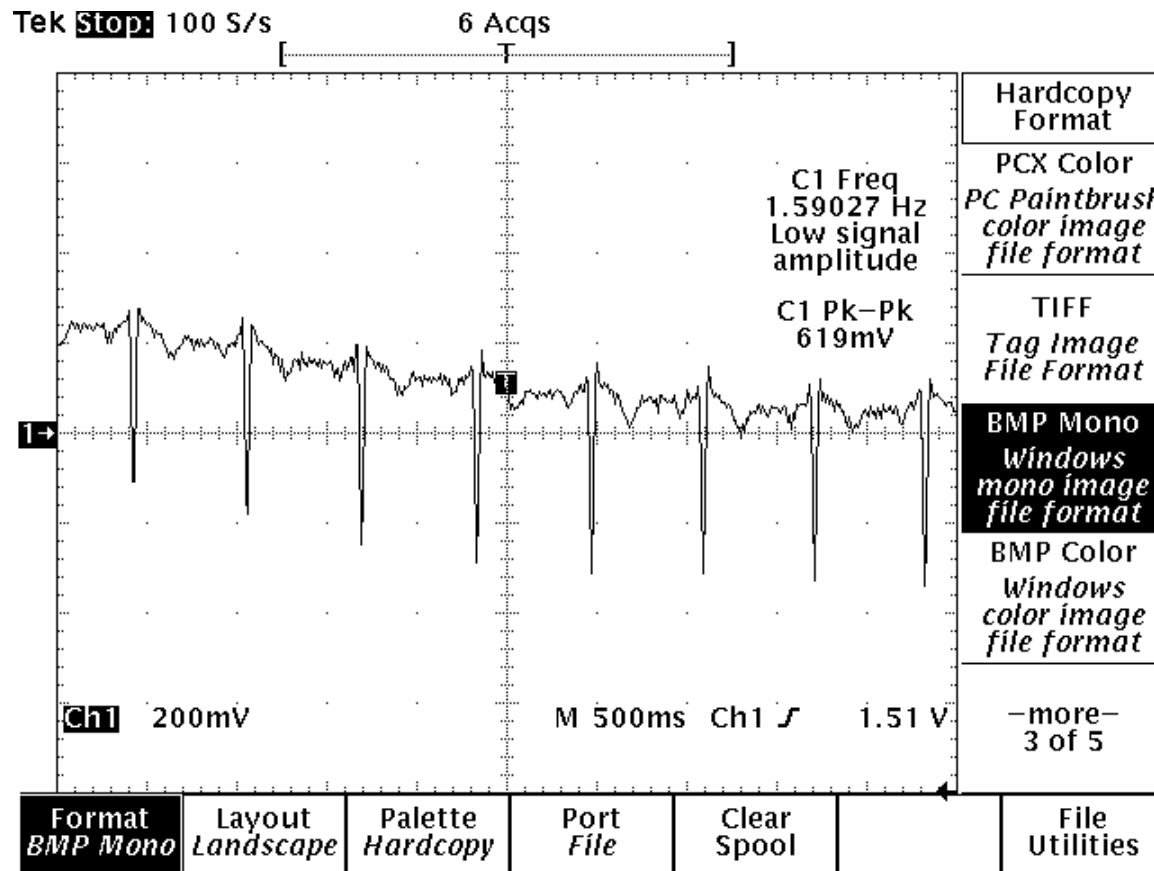
Amplifier Schematics



ECG Waveform 1



ECG Waveform 2



Temperature Sensor

- Contact device desired to provide accurate reading of body temperature
 - supplier could not provide sensor
- Used ambient sensor to replace contact sensor
 - provided acceptable output for testing purposes
 - required amplification for improved dynamic accuracy

Scalability

- Easily expandable for more sensory inputs
 - add A/D converter
 - add few lines of code to Basic Stamp

Data Conversion and Transmission

- Analog to Digital Converter
- Basic Stamp 2
- Transmitter and Receiver
- TTL to RS-232

A/D converter

- Sensors output analog signals which need to be converted to digital signals
- 8-bit conversion maps 0-5 Volts to a byte representing 0 to 255
- A/D selected by Basic Stamp and outputs serial TTL

Basic Stamp 2

- Used to combine multiple sensor outputs in order to transmit on one frequency
- Alternates between sensors' digital signals and sends them into the transmitter
- Provides a clock and enable signals for A/D converters
- Adds delimiters to make it easier to separate and analyze data in LabVIEW

Transceiver

- Decision on transceiver type

- Motorola MC13176

vs.

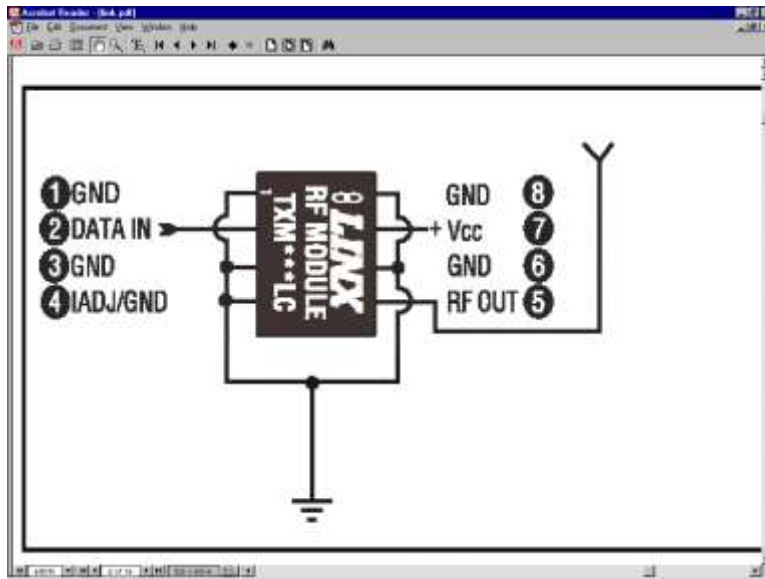
Linx Modules

- Factors

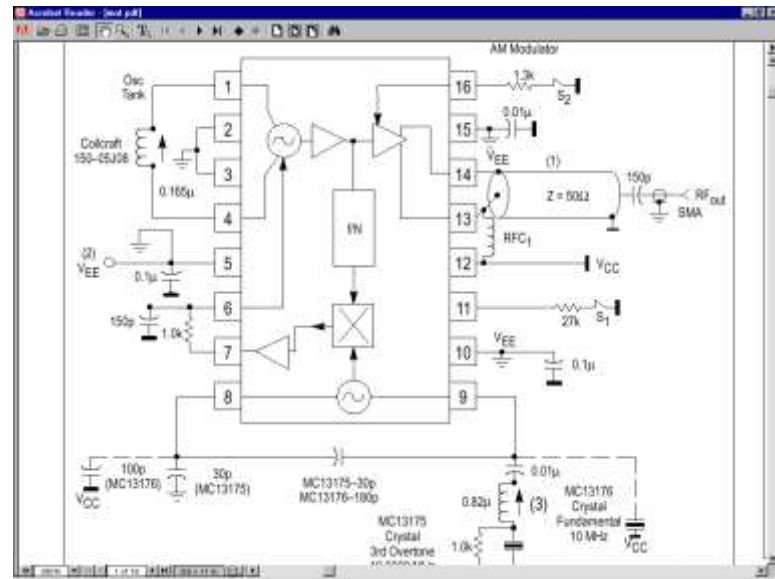
complexity of transceiver

compactness of unit

Comparing Transmitters



LINX module



MC13176

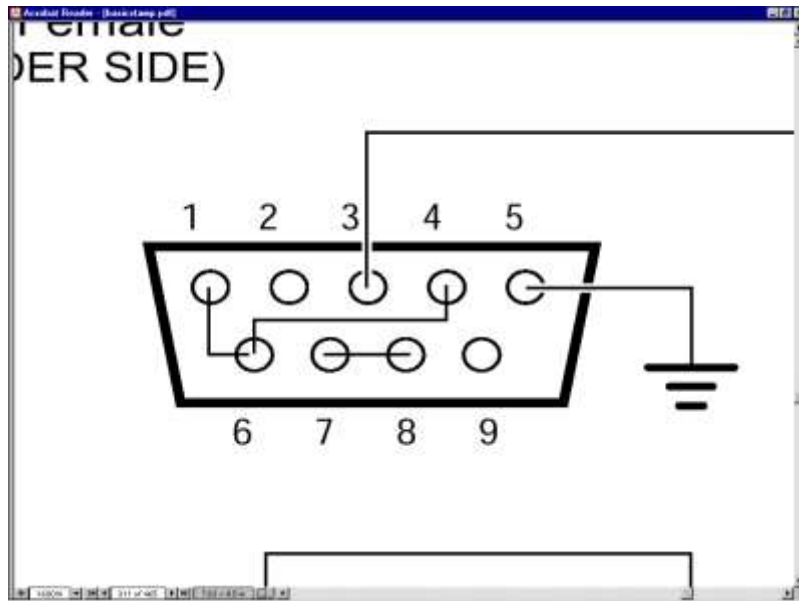
LINX modules

- Easy to implement transmitter and receiver
- Does not require extensive external circuitry
- Transmits digital data

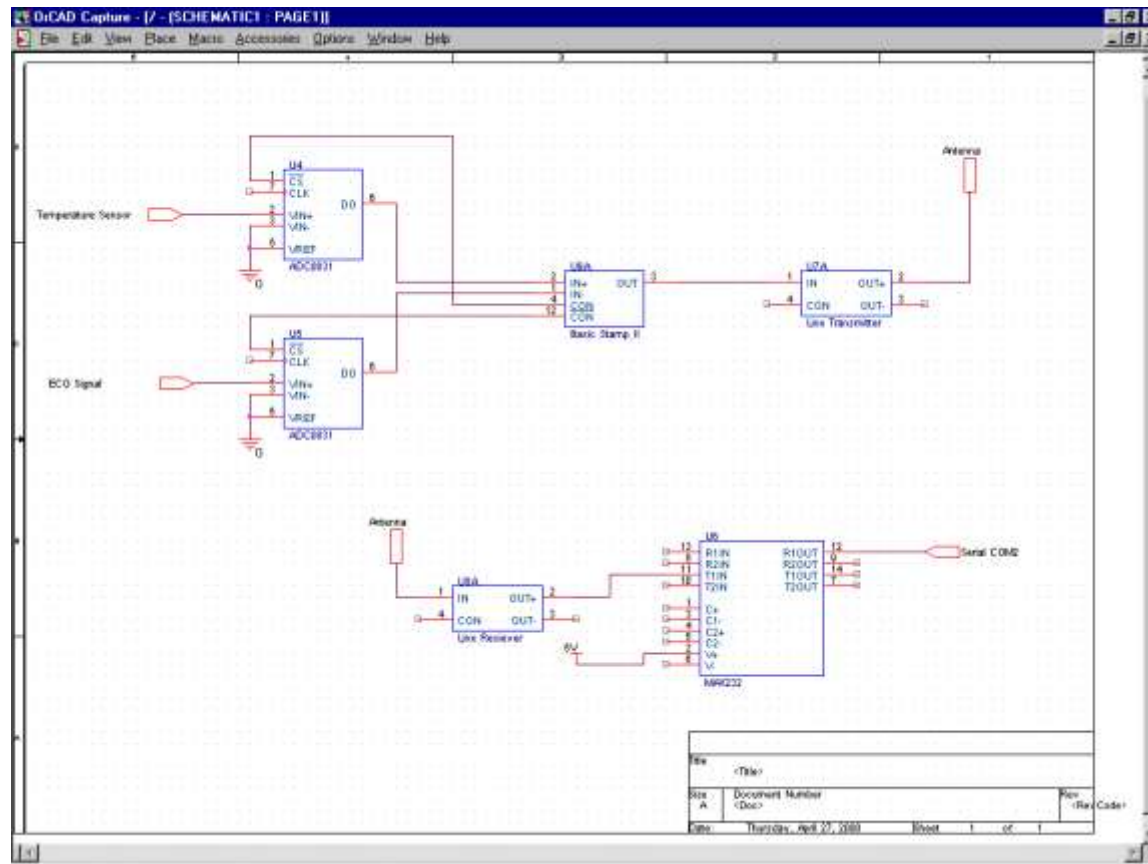
Receiver

- Meets design specifications for receiving data up to 30 feet
- Use MAX232 to convert data for serial input into PC
- Make serial connection to PC

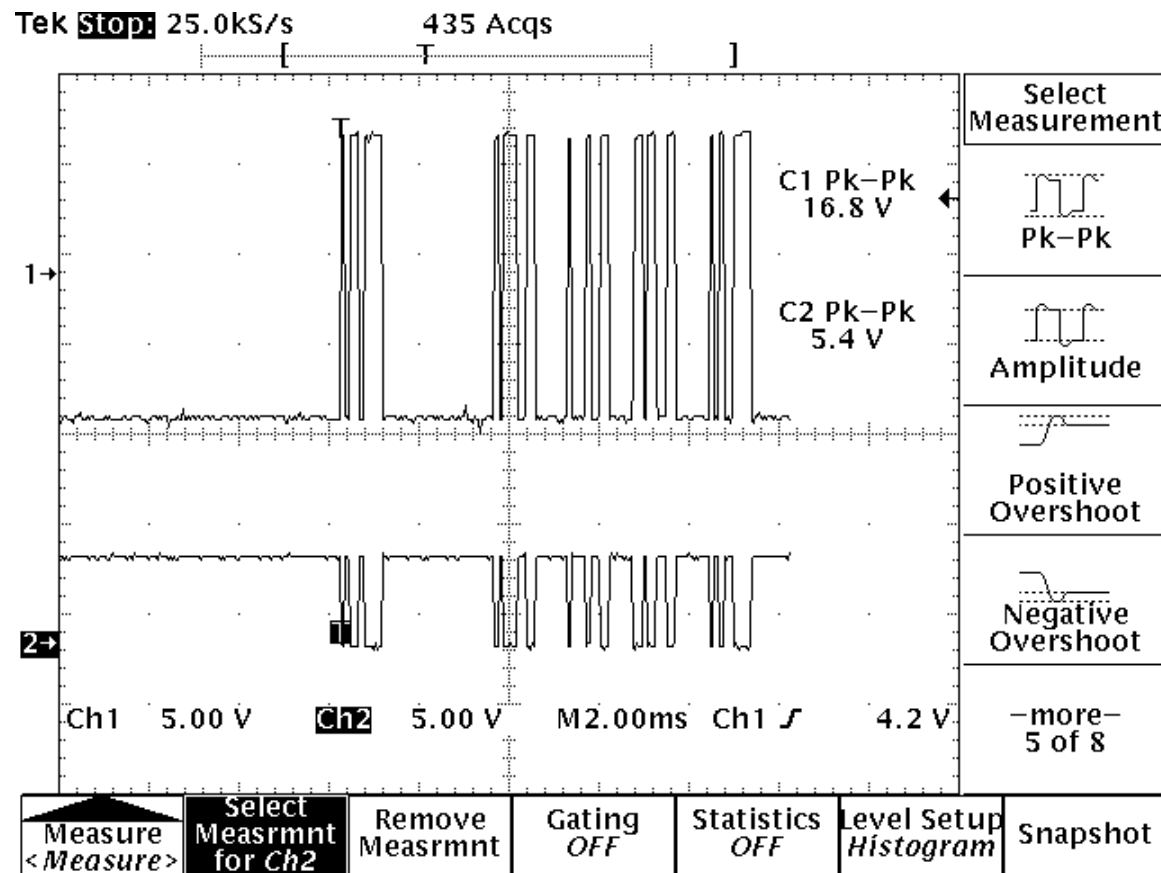
RS-232 Wiring



Digital Transceiver Schematic



BS2 Output vs Serial Input



LabVIEW

- Used to display and analyze data
- Suitable for serial port applications
- Provides user with interactive display
- Ease of programming

Importing Data

- Data acquired through serial port
 - serial port read program available in LabVIEW
- Used delimiters to separate two signals for processing
- Sampling rate limited by A/D converters

Processing Data

- Obtaining heart rate from simulated ECG using function generator
- Converting temperature data to degrees Fahrenheit
- Comparing data to predetermined thresholds set by user (physician)

Display

- Waveforms and data displayed in real-time
- Front panel indicators show when vital signs reach thresholds
- Call for medical attention made when thresholds reached

LabVIEW Front Panel



Problems and Challenges

- Building blood pressure unit
- Obtaining proper temperature sensor
- LINX module transmitting at fixed frequency
- Importing ECG data to LabVIEW
- Noise in bench supply voltages

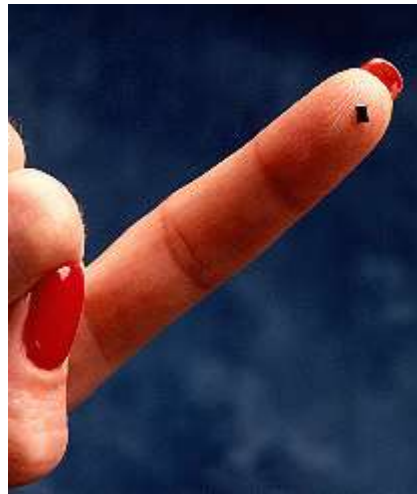
Improvements

- Contact temperature sensor
- Better A/D's
- Housing for circuit
- Data Acquisition Card for LabVIEW
- Open communications channel for help

Possibilities

- Integrate GPS
- Compact and comfortable
- Expanded analytical capabilities
- Display on telemetry unit
- Dispense medication

Medical Telesensor



Measures and Transmits Body Temperature (ORNL)

Commercial ECG Telemetry



MYCswl.com Ultraview Modular Digital Telemetry (Spacelabs Medical) www.mycswl.com

Thanks

We'd like to express our appreciation to Dr. Thomas Ferrell of Oak Ridge National Laboratories, Shao Hsia, Lee Rumsey, and Prof Andrew Webb for their contributions to the success of our project.

Conclusion

We feel this is the future of health care in a system of rising costs and patient volume. It provides more efficient means of monitoring patients as well as providing the patient with peace of mind without being restricted to a hospital bed.